Voyager

B U L L E T I N

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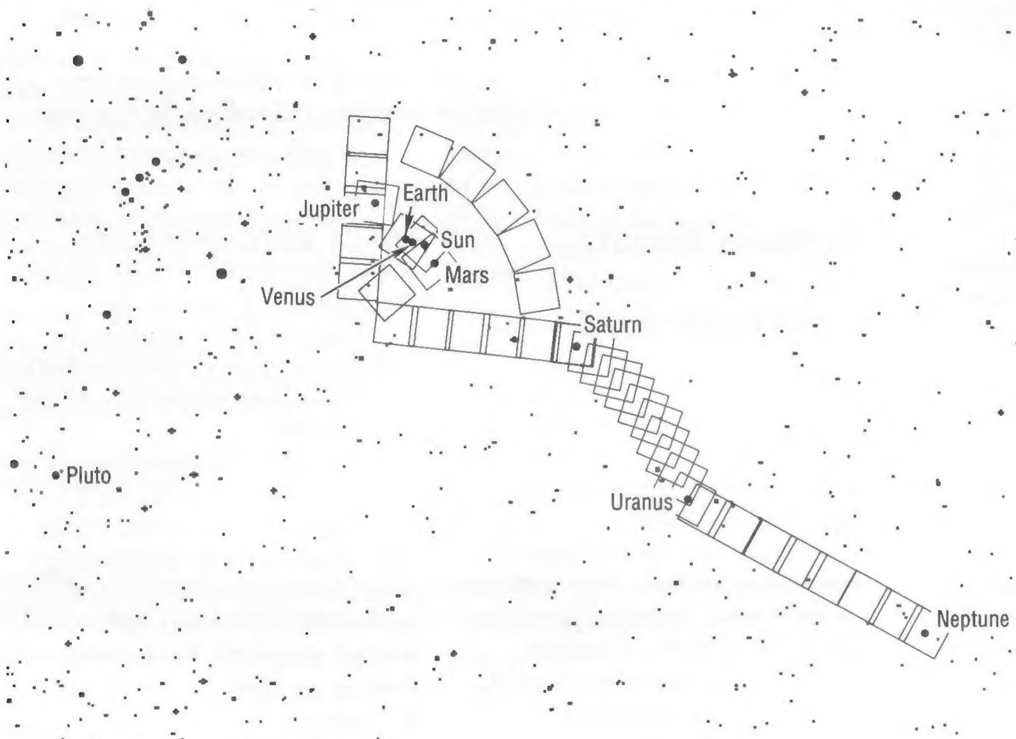


Voyager 1's unique vantage point will allow the spacecraft to sweep its cameras across the solar system, capturing images of most of the planets. The footprints of the wide-angle camera frames are shown.

Solar System Images: Say "Cheese!"

On February 14, Voyager 1 will take advantage of an historic and unique opportunity to image most of the solar system's planets, taking a final look back at where the Voyagers have been and showing Earth among its fellow planets.

Earth, Venus, Jupiter, Saturn, Uranus, and Neptune will be targeted in a sequence of wide- and narrow-angle images. Mars may be visible, but it will be a slim crescent close to the Sun, while Mercury will be masked in the Sun's glare. Pluto is too far away and too small to be imaged. From Voyager 1's viewpoint, the planets will appear to be clustered along the constellation Eridanus (The River).

Voyager 1 will be approximately 40 astronomical units (AU) from Earth and 32° above the ecliptic plane at an ecliptic longitude of 242°. A series of about 64 images will be taken, beginning with Neptune. The wide-angle frames will be taken through clear filters, while the narrow-angle frames, each centered on a planet, will be shuttered through blue, violet, and green filters. The spacecraft will roll to take images of regions that would otherwise be obscured by the spacecraft's high-gain antenna. Images of

the inner planets will be mosaicked around the Sun to avoid direct sunlight. The final wide-angle frame will be centered on the Sun.

Due to tracking schedules, the images will be recorded on board the spacecraft and returned to Earth in late March. Several weeks will then be needed to process the images to reveal as much detail as possible. Most of the planets will be smaller than a pixel in size; however, Jupiter may be as large as four pixels. (Voyager's imaging frame is 800-by-800 picture elements, or pixels.)

Due to the scale, it is unlikely that the entire set of images can be mosaicked to produce for publication a single photograph showing all the planets stretching from Jupiter to Neptune. A display of this mosaic would require a wall 100 to 150 feet long, depending on the chosen size of the individual prints. Imaging team members hope to release at least the central frames showing Earth, Venus, and perhaps Mars together.

Voyager 1 was chosen over Voyager 2 for this task due to operational considerations. Another factor is the fact that Jupiter would be too close to the Sun to be visible from Voyager 2's point of view this spring.

Although the ultraviolet spectrometer is still on, the sunlight will be too bright to allow observations during this imaging sequence. The infrared spectrometer and photopolarimeter instruments will not be on. The only potential damage from pointing these optical instruments too close to the Sun is that the shutter blades of the wide-angle camera might warp due to the increased heat of the sunlight focused on the blades.

Update

Contact with Voyager 1 has been normal since a partial loss of contact last fall. On October 23, Voyager 1 stopped sending its telemetry signal, by which science and engineering data are transmitted. The carrier signal, a single frequency used to track the spacecraft's location, continued. Commands were sent to reset the spacecraft's telemetry modulation unit. Controllers waited 11 hours for the signal to reach the spacecraft and a return signal to reach Earth before they knew that full contact had been restored. Flight controllers had no explanation for the one-time event, but there was some conjecture that it was related to high solar activity. Several other spacecraft also experienced computer problems during last fall's spate of huge solar flares. The high-speed particles ejected by solar flares can cause computer bits to "flip" from the desired position.

Voyager 2 has completed its post-Neptune instrument calibrations and has begun its Interstellar Mission, the search for the edge of the Sun's influence.

Neptune Results

The Voyager science teams have submitted their "30-day reports" on the Neptune encounter, as required in their contracts with NASA, and these reports have been published in the December 15, 1989, issue of *Science* magazine. As the papers were being written, data analysis continued, bringing new information to light. Changes from what has been previously reported in the *Bulletin* are summarized below.

Neptune's rotation rate is now cited as 16 hours 7 minutes ±1 minute, based on data from the planetary radio astronomy instrument.

Winds near the Great Dark Spot are now believed to be a rip-roaring 560 meters a second (1230 miles an hour), the strongest winds yet measured in the solar system. (Voyager measured winds on Saturn up to 500 meters a second or 1100 miles an hour.)

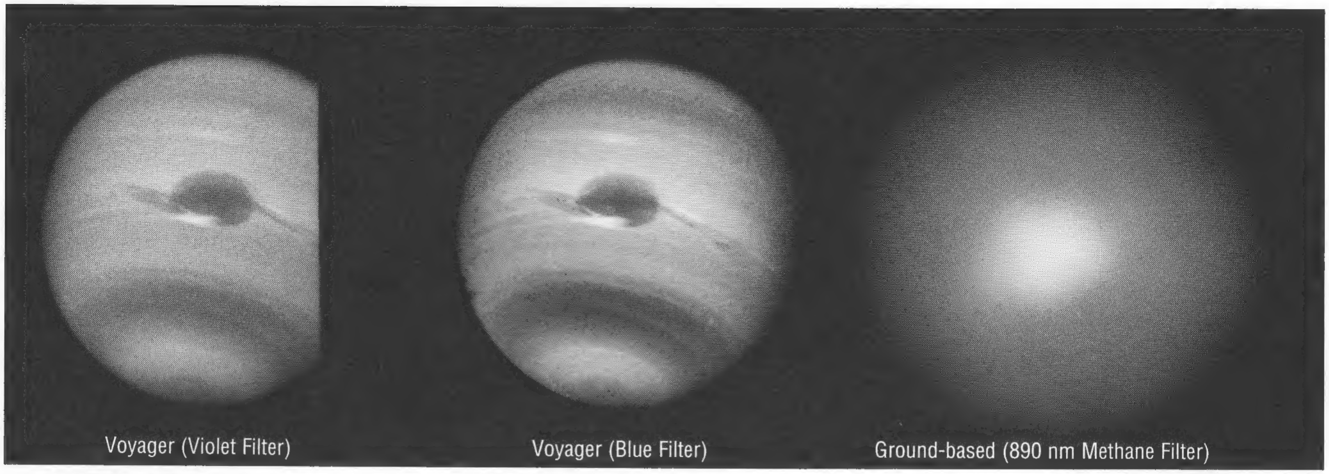
The cloud streaks seen near latitudes of 27°N and 71°S are estimated to be about 100 kilometers (60 miles) and 50 kilometers (30 miles), respectively, above the cloud banks on which their shadows were seen.

Temperatures at high altitudes in Neptune's stratosphere have been measured to be about 750 kelvins.

The tilt of Neptune's magnetic field is now given as 47° from the rotational axis, while the offset of the magnetic pole from the center of the planet is 0.55 radius. The strength of the surface magnetic field varies from more than 1 to less than 0.1 gauss.

As Voyager 2 passed through the ring plane, the maximum impact rate from ring particles was measured at 250 hits per second.

Triton's surface temperature has been revised to 38 kelvins (about -391°F), while the surface pressure is now believed to be about 14 microbars. Methane and nitrogen form a thin veneer on the moon's surface, while the underlying topographic features are suspected to be formed of water ice. Methane and nitrogen ices are too weak to support



Images of Neptune taken on August 24, 1989 indicate that the bright feature seen in ground-based images is the bright companion associated with the southern edge of the Great Dark Spot. (Right: University of Hawaii's 2.2-m telescope on Mauna Kea [Observer: H. Hammel].) (P-35061)

their own mass for very long in such formations.

At least six small, previously unknown satellites, ranging in diameter from 54 to 400 kilometers, have been identified in Voyager images. Their orbital elements are given in the accompanying table. Names will be assigned by the nomenclature committee of the International Astronomical Union (IAU).

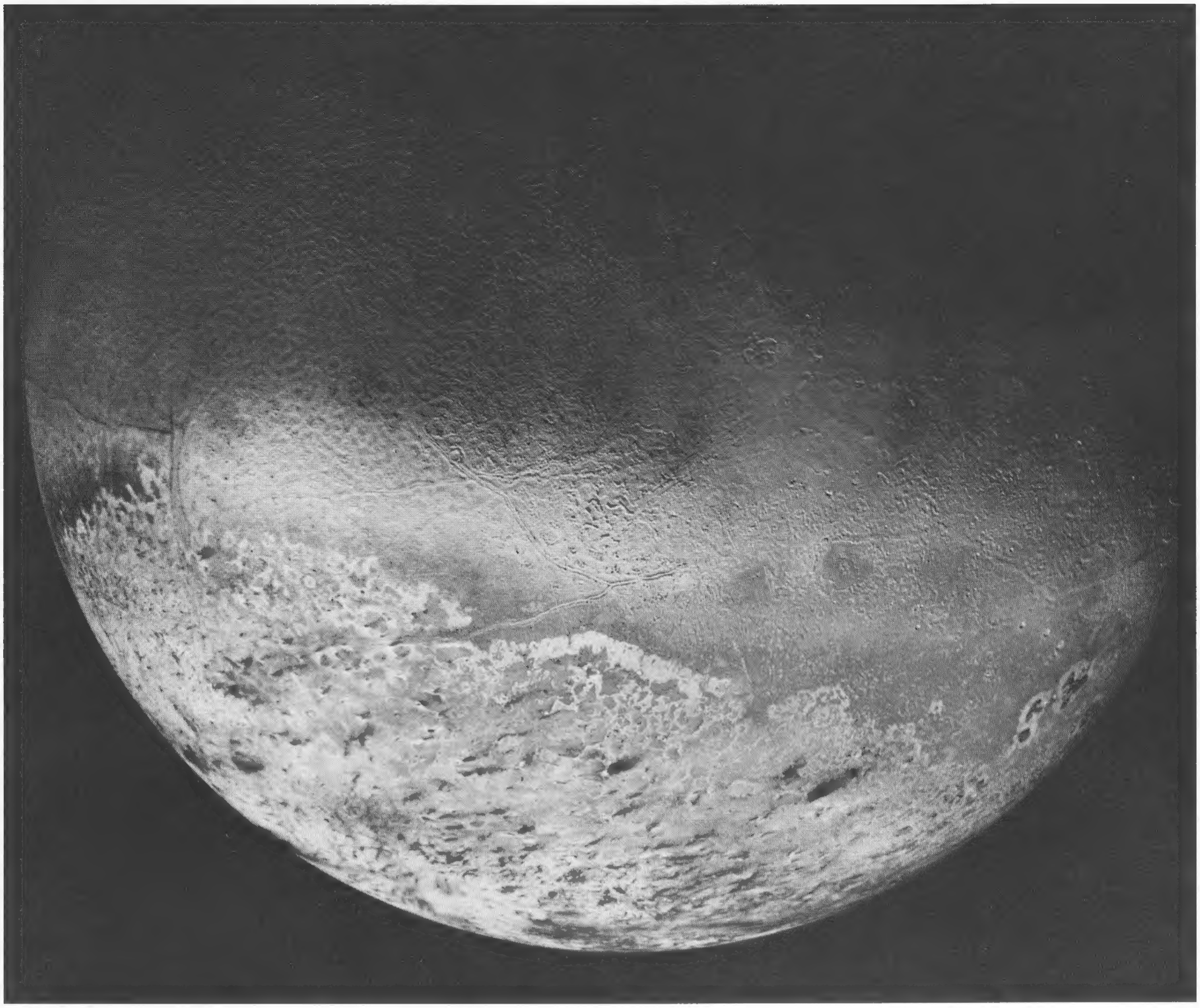
Researchers will continue to publish science results of the Voyager mission in professional journals such as *Geophysical Research Letters* and the *Journal of Geophysical Research* for many years to come. The Voyager mission has provided a unique data set for comparative planetology: four planetary systems studied by the same instruments.

Neptune's rings and moons.

Ring*	Orbital Radius (from Center of Neptune)**	
1989N3R	17,100 km	(10,600 mi)
1989N2R	28,400 km	(17,700 mi)
1989N4R inner edge	28,400 km	(21,100 mi)
1989N4R outer edge	34,200 km	(21,300 mi)
1989N1R	38,100 km	(23,700 mi)

Moon*	Orbital Radius (from Center of Neptune)**		Orbital Period	Diameter	
1989N6	48,000 km	(29,800 mi)	7 hrs 6 min	54 km	(33 mi)
1989N5	50,000 km	(31,100 mi)	7 hrs 30 min	80 km	(50 mi)
1989N3	52,500 km	(32,600 mi)	8 hrs	150 km	(90 mi)
1989N4	62,000 km	(38,500 mi)	10 hrs 18 min	180 km	(110 mi)
1989N2	73,600 km	(45,400 mi)	13 hrs 18 min	190 km	(120 mi)
1989N1	117,600 km	(73,100 mi)	26 hrs 54 min	400 km	(250 mi)
Triton	354,800 km	(220,500 mi)	5 days 21 hrs	2705 km	(1690 mi)
Nereid	5,488,600 km (avg)	(3,410,600 mi)	360 days 3 hrs	340 km	(210 mi)

* Moons or rings are numbered in order of discovery.
** Subtract one Neptune radius (24,764 km at 1 bar pressure level, at equator) to calculate distance from Neptune's cloud tops.



Voyager 2's highest resolution view of Triton was of the hemisphere that always faces Neptune. Most of the geologic structures on Triton's surface are likely formed of water ice, because nitrogen and methane ice are too soft to support much of their own weight. Several geyser-like vents spew nitrogen gas laced with extremely fine, dark particles. (P-35317)

NASA

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

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Editor
Anita Sohus (818) 393-0683

Technical Review
Dr. Ellis D. Miner

Public Information Office
(818) 354-5011

Public Education Office
(818) 354-8594